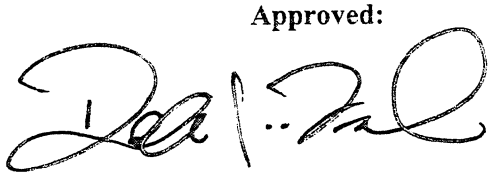
QUARTERLY PROGRESS REPORT
DRD 875MA-003
April 2004 – June 2004

Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179

Approved:



Randall S. Reed, Program Manager
MSFC S&MA Mission Services

July 16, 2004

Hernandez Engineering, Inc.
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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's third quarter of the third option year: April 2004 through June 2004.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The third quarter of the third option year of the S&MA Mission Services contract was successfully completed on July 4, 2004. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/ Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b)(4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost under-run at the end of this period---see the June 2004 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. [

(b)(4)]

HEI received five Technical Directives (TDs) from S&MA during this period. These TDs were as follows: 1) Jovian Icy Moon Orbitor (JIMO) Reliability and Lessons Learned Support; 2) JIMO Systems Level Fault Tree; 3) Orbital Space Plane (OSP) Futron Extension; 4) Risk Management Supplemental Support; and, 5) Safety, Health and Environment (SHE) Committee Support.

4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group performed 110 OSHA compliance annual facilities inspections and provided all required reports in a timely manner. Also, IS performed 488 construction site compliance

inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the SHEtrak database in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) participated in three pre-construction conferences; (2) participated in 13 final safety inspections of facilities under renovation or construction; (3) reviewed 87 sets of facility design drawings for compliance with OSHA and consensus codes; (4) assisted the Industrial Safety Department (ISD) develop and process, for web page posting, seven Safety Bulletins and five Shop Talk safety information topics; (5) participated as instructor on identification of hazards in the workplace for one training class for Building Managers and Their Assistants; (6) taught two training sessions to supervisors on how to perform monthly workplace safety visit inspections; (7) taught one training session on S&MA Safety and Quality monitors of Program Hardware/Critical Lifts; (8) updated two facility emergency/fire evacuation plans; and, (9) performed 14 periodic fire drills.

Although not a designated contract year Area of Emphasis (AOE), IS agreed to continue the emphasis to increase awareness of identifying Unsafe Acts in the workforce. IS identified 12 Unsafe Acts with emphasis on on-the-spot corrections and prepared numerous general safety awareness communication messages for ISD to distribute to Center employees. To assist in this effort HEI continued to provide an experienced senior Industrial Safety engineer to assist the ISD identify Unsafe Acts. In addition, this same part-time employee surveyed 338 locations to assure adherence to Lockout/Tagout requirements when working on energized systems and monitored construction and maintenance activities after normal work hours and weekends.

IS continued to provide to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: (1) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; (2) prepared monthly SHE communications plans; (3) developed multiple innovative safety awareness communications materials including safety announcements on MSFC TV; (4) on a voluntary basis, IS continued to assist the SHE Committee Chairperson and ISD support bi-monthly SHE Committee meetings, including collection and organization of pre-meeting briefing charts, serving as recorder, and preparing draft meeting minutes; and, (5) in support of a new S&MA Technical Directive, HEI initiated additional administrative and technical support to the SHE Committee to assist with annual SHE Program progress reports and tracking of SHE actions.

IS initiated, completed or followed-up on more than a dozen hazard analyses. Examples include: (1) completed a Safety Assessment (SA) for the KT-Engineering Phase II testing at Test Stand 500; (2) completed a SA for the SSME LAI Testing on the SSME Liquid Hydrogen Pump at building 4626; (3) initiated a SA for the AF-M315 Monopropellant Hot-Fire testing at TS115; (4) prepared engineering notes for the Simulated Fission Testing in building 4205; (5) continued an Operational Hazard Analysis (OHA) for the Orbiter Boom System (OBSS)/Inspection Boom Assembly (IBA) transportation and handling operations at MSFC; (6) assisted HEI's System Safety perform an independent SA for operating the Global Electric Motorcars (GEM) on MSFC and Redstone Arsenal roadways with posted speed limits greater than 35 MPH; and, (7) continued to perform SA's for the new high visibility Propulsion Research Laboratory (PRL), which began beneficial occupancy in May, 2004.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. IS advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment usage in support of the MSFC SHE Program. Also, IS continued to perform an OHA and a FMEA for the overhead crane to be used during testing activities to support OBSS/IBA testing in building 4619. Also, HEI is preparing a

Critical Lift Overhead Crane Certification Package, which includes a FMEA, for the newly refurbished cranes in building 4755. Following a very short-notice, HEI served as a critical lift handling operation safety monitor for an ECLSS Rack in building 4708. Also, IS continued to be an active participant in the Lifting Device Equipment (LDE) SHE subcommittee. In support of the task to administer proficiency exams to civil service and contractor operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts, IS administered hands-on proficiency examinations to 21 overhead crane, 30 forklift, and 7 aerial lift operators in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide
to the MSFC Test areas. Examples of support included: (1) reviewed and approved multiple operating and test procedures for hazardous operations; (2) continued to review Quantity Distance (QD) requirements for the Real Time Radiography of the 24-inch Motor Test at STPA Test Stand; (3) assisted ISD determine storage requirements for explosives (propellant) at building 4564 and reviewed procedures for dispensing and ignition of monopropellant in the new PRL facility; (4) as an additional duty, served as the alternate safety representative for test area facilities; and, (5) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

4.1.2 System Safety Engineering

System Safety Engineering (SSE) reviewed Nuclear Safety requirements relative to the Electrical Power System (EPS) and worked assigned trade studies to provide top-level evaluation of multiple capture and docking configurations for the JIMO.

SSE completed support to the Orbital Space Plane (OSP) Lessons Learned activities.

SSE completed the first phase of support for the HRLV System Requirements draft development effort. SSE is the designated lead for S&MA on this task number RFT 0007.04 MSFC, and has submitted the initial draft white papers which include rationale, assumptions and implications.

SSE as designated OPR for the S&MA handbook development effort, completed and submitted the schedule for the handbook reviews and submittal. The next team meeting will occur on July 7, 2004 to review the current version of the draft handbook.

SSE supported the follow-on review to past waiver inputs and conducted a review of several new waivers with S&MA lead for the DART Program. SSE reviewed the final Missile System Prelaunch Safety Package for the program and provided comments.

SSE supported the X-37 Program by participating in the Flight Termination System (FTS) Critical Design Review (CDR) by teleconference on March 30, 2004 and supported the Approach and Landing Test Vehicle (ALTV) Hazard mitigation and verification review by teleconference on March 31, 2004.

SSE supported seven SSP S&MA Panel Telecons during the reporting period that included a presentation on the "current" proposed revisions to the SSRP Charter.

SSE has begun to write the preliminary material hazard analysis for the ROCR project. However, the Preliminary Design Review (PDR) scheduled for June 24-25, 2004 has slipped, based on a material change. The Team supported a meeting at Johnson Space Center (JSC) to ensure that proper coordination of all tasks, identify and address all on-going issues.

SSE participated in discussions concerning aft stiffener ring criticality and ply lifting on June 9-10, 2004. Also, SSE attended the firing for the full scale static test motor, FSM-11, on June 10, 2004.

SSE supported the Nozzle TIM held at MSFC June 14-15, 2004. The main topic of discussion was the ply lift issue. Basically, the presentations focused on possible causes of ply lifting. Further evaluation/data will be provided after the FSM-11 nozzle is dissected. The conclusion drawn based on the presented data is that the ply lift phenomena is not well understood and will require further characterization and study.

SSE supported the RSRM Inactive Stiffener Stub Closeout redesign PPR/PDR activity held at MSFC (and other telecon sites) June 24, 2004

SSE is reviewing the draft fault trees for the new integrated hazard reports (INTG HRs) that will be generated for the Space Shuttle's main propulsion system (MPS). The SSE has supported nine reviews by reviewing fault trees and other data in advance, and participating in a propulsion systems integration group (PSIG) review of the Integration group's preliminary fault trees for the MPS.

SSE attended the S&MA Summit #2 at the Michoud Assembly Facility (MAF) on May 26, 2004, to discuss the Hazard Report T.02 Loss of Thermal Protection System (TPS). SSE reviewed the preliminary logic trees for ascent and pre-launch and causes, reviewed and responded to resulting updates, and attended the next S&MA Summit on T.02 Loss of TPS.

SSE attended and participated in the RTF Pre-board meeting on Instrumenting the ET Cable Trays for RTF. SSE attended the subsequent RTF Pre-board meeting on April 22, 2004 and stated the S&MA position for the need of instrumentation of the Cable Trays.

SSE supported the Bipod Redesign as follows: 1) lead the Bipod Team by performing a PFMEA on the Validation Wedge Spray; 2) approved the MPP for the Validation Wedge Spray; 3) provided input, and test support to the Double Sided Tape Issue; 4) attended the Bipod Redesign Delta CDR Pre-Board held on June 16, 2004 at the MAF. SSE briefed the QD20 Manager, who was a Pre-Board Member, on the issues concerning the bipod redesign in preparation for the Pre-Board; and 5) attended the Bipod Redesign Delta CDR Board held on June 24, 2004 at the MAF providing data for Review Item Discrepancies (RIDs) initiators for potential closure.

SSE is supporting the review and approval of numerous ET Accepted Risk and Controlled Risk Hazard Reports as well as FMEA/CIL items which are at various stages of review.

SSE provided ET S&MA support for Integrated Fault Tree Tiger Team reviews. There are currently 13 Integrated Tiger Teams defined whose task is to baseline initial FTs (developed by SE&I contractor) to ensure adequate and accurate identification of all SSV integrated hazardous condition causes including title, description, mission phases, potential effects and elements.

SSE provided ET S&MA review and comments for Change Request (CR) CR62260 which updates NSTS 22254 "Methodology for Conduct of Space Shuttle Program Hazard Analysis" to include/clarify Integrated Hazard Analyses and responsibilities.

SSE is working to generate coordinated response to Independent Assessment (I/A) questionnaire for ET Project on methodology and closure of PRCB RTF directive for review of Accepted Risk HRs and applicable CILs.

SSE supported the RSRM element by attending the BSM cracked throat problem in the carbon element on April 26, 2004, during which several scenarios were presented as the potential causes for the throat cracking problem seen in some fired BSM's, and attending the SRB Bolt Catcher CDR the week of April

27-30, 2004. SSE reviewed the CDR package, hazard reports, and fault trees for the new design Bolt Catcher.

SSE has supported the Nodes 2 and Nodes 3 project by supporting team meetings, updating hazard reports, closing and tracking verifications, attending Special Topic TIMs meetings with the SRP (in person and by telecon) for both Nodes, and rescheduling the delta Phase II flight safety review for Node 3. SSE supported the Oxygen Generation System (OGS) by resolving an SRP Action Item for the project to resolve toxicology issues related to designing for maintenance operations and hydrogen venting into building 4708 issue such that the venting will be routed through an existing vent. Additional OGS efforts include evaluating software changes and adding new controls which will be formally presented at the SRP Phase II Delta Review, supporting an ISS Safety Review Panel Special Topics Meeting on Rack vs. ORU Replacement of the Oxygen Generator, reviewing and providing updates for Flight and Ground Hazard Reports and Verifications, separating out the ECLS portion of the Node 3 hazard reports into separate stand alone reports as requested by the project, updating the Node 3 Hazard Control Verification Traceability matrix, and developing a set of OGS (OGA plus PSM) level hazard reports which are separate from the Node 3 level reports and deal only with ELCSS OGS hardware.

SSE supported the Water Recovery System (WRS) by participation in Urine Processor Assembly (UPA) team meetings, the Water Processor Assembly (WPA) team meetings and the WRS integration meetings, supporting the Water Processor Assembly (WPA) Functional Configuration Audit (FCA) at Hamilton, updating Hazard Reports, the Waste Water Storage Tank Assembly (WSTA) Test Readiness Review (TRR), and met by telecon with representatives of the Payload Safety Review Panel (PSRP) to discuss the need for updating MPLM/Orbiter hazard report MOI-7. As a result of this meeting, Payload Safety Engineering (PSE) made the recommended changes to the MOI-7 update. This hazard report is expected to be approved by the PSRP. SSE also supported the WRS by reviewing and providing comments to several draft presentations for the WPA Special Topics meeting with the International Space Station (ISS) Safety Review Panel (SRP), reviewing four (4) UPA test procedures, reviewing ALERT's, CR's (Change Requests), NCR's (Non Compliance Reports), PIRN's (Program Interface Revision Notices), and updating the GSRP (Ground Safety Review Panel) an updated description of the MPLM PTS (Programmable Thermostats System) GSE (Ground Support Equipment) and an overview of its expected use.

SSE supported the Biological Research Project (BRP) by participating in BRP team meetings and Acceptance Review, providing a copy of both the Integrated Habitat Holding Rack (HHR) Ground Safety Assessment and an updated BRP S&MA Plan for review, reviewing and providing comments and responses to two (2) PSRP action item submittals by Boeing-Huntsville, ten (10) ALERTs, and signed two (2) Manufacturing Action Requests (MARs), three (3) Engineering Change Papers (ECPs) for the Project, providing minor changes of two (2) Hazard Reports. SSE also supported BRP by participating in the FD26 System Problem Resolution Team (SPRT) meeting, the Boeing Program Management Review, and the Quarterly BRP meeting at Ames Research Center.

PSE supported the Materials Science Research Rack (MSRR-1) by investigating, discussing and resolving the Fairchild fastener issue, organizing a meeting with the Project Managers for MSRR-1, MSRR-1 Integration & Operations, and GEDS, plus support personnel to identify and discuss the Phase III flight and ground safety review process to determine the appropriate milestones, supporting the Experiment Carrier (EC) Trainer Acceptance Review, and supported a team review of the impact of alternate carriers for MSRR-1.

PSE reviewed the use of Parker Quick Disconnects (QD's) on the Microgravity Science Glovebox (MSG) facility. This was initiated by two PRACA's items which explained a failure associated with these QD's. The use of these connectors resulted in not being a safety related issue in MSG. PSE also assisted the

MSG Lead Systems Engineer in writing a proposal to extend the safety certification of the MSG. The PSRP agreed with the proposal at an in-board review on May 13, 2004. Additionally, PSE and other S&MA disciplines have completed the MSG S&MA Plan which has been submitted for final review.

SSE provided S&MA Lead support in the process of shipping QMI ground and flight parts to TBE as part of the SDOS contract. SSE continues to work with NASA and TBE representatives to ensure hardware is shipped per the SDOS contract and Letter of Delegation. Several Engineering Order's (EOs) were signed to support ongoing work.

SSE has received team comments to the draft Phase III Flight Safety Data Package. These comments will be compiled and incorporated into the version that will be submitted with the documents to be stored for possible future use.

PSE has reviewed the final thermal analysis report for loss of cooling with Delta-L operating in the MSG, used it to rewrite the description of the touch temperature hazard on the standardized hazard reports (JSC form 1230) for the integration of Delta-L with the MSG, and submitted the reports to the MSG managers for signature.

PSE supported the Glovebox Integrated Microgravity Isolation Technology (g-LIMIT) project by evaluating an EPL change to add an alternative solder for use on one of the PSC boards. The EPL had no effect on safety. PSE has also supported Verification and Validation (V&V) testing of the flight software installed on the Flight Unit Spare (FUS), performance testing, and investigation of test anomalies with the Flight Unit Spare (FUS). A team, including S&MA, has being formed to develop a Fault Tree Analysis to determine the cause(s) of the problem.

PSE briefly supported the proposed re-flight of the Solidification Using A Baffle In Sealed Ampoules-02(SUBSA-02) Flight Experiment by drafting a schedule of activities necessary for launching and processing new ampoules, submitting data for a toxicological evaluation, and presenting safety related issues that needed to be resolved during the three weeks prior to cancellation of the activity.

PSE reviewed and commented on the Smoke Point In Co-Flow Experiment SPICE Phase II Safety Data Package in support of the LF-1 mission.

PSE has made comments to Extreme Universe Space Observatory EUSO Preliminary Safety Assessment which is at Phase A, based on a review of the EUSO Safety Data Pack and Operations Flight/Ground documents. Comments were submitted to both the EUSO Project Manager and the PSRP. The PSE also attended the EUSO Level 0 Safety Technical Interchange Meeting (TIM) with the PSRP in Houston, TX.

PSE drafted a preliminary hazard report for a proposed magnetic device designed to shield spacecraft from radiation. PSE talked with the Systems Engineer and reviewed the Alpha Magnetic Spectrometer-02 (AMS-02) Phase 0/1 Flight prior to and during the analysis to gain a better understanding of general hardware operations and potential hazards based on the AMS-02 design which has numerous similarities. PSE delivered a Preliminary Hazard Analysis (PHA) report for the proposed magnetic device designed to shield spacecraft from radiation. The report noted several technical areas that would require in-depth evaluation as the design progressed. However, the PSE only identified two major issues/concerns – the inability to restart of the magnetic field after a quench event, which would create a hazardous situation and that the design, technology or testing could not verify the effectiveness of proposed hazards controls.

PSE supported the 2004 Payload and Mission Success Conference. The conference started with a refresher course on the payload safety process and requirements. Several general sessions were attended where speakers from various NASA organizations spoke about the new vision for NASA and/or the

implications of the Columbia Accident Investigation Board (CAIB) report. HEI engineers gave two (2) presentations that were well received at the conference. All sessions were attended by at least one PSE and notes will be gathered and combined with presentation slides for future reference. Topics included: ISS Payload Operations and Integration Safety, Launch site Operations at KSC, Probabilistic Risk Assessment (PRA) for payloads, Safety and Mission Assurance and the European Space Agency (ESA), and Science Opportunities on ISS – US Lab and requirements for payloads using either the Progress or Soyuz among others. All sessions attended were informative with the exception of the PRA session due to the fact that the presenters seem to skirt the issue of why PRA's were a good tool to support the programs.

HEI Project Assurance (PA)/SSE continues to work with HEI and S&MA management to evaluate support provided to QS30 in the areas of System Safety, Quality, and Reliability/Maintainability. As the ramifications of the new NASA Vision are revealed, PA will work with QS30 to ensure resources are allocated properly.

SSE completed revising the Draft S&MA DRDs and participated in discussion held with QD40 and ED43. Based on the results of that meeting, a further update was developed to address remaining format and content issues.

In response to a request from QD40, SSE reviewed the disposition of 22 MSFC comments on the draft NASA-STD-8719.13B, *NASA Software Safety Standard,* submitted earlier. The draft development team provided additional information to support the re-consideration of the five comments that were not accepted.

SSE representatives participated in a Safety and Mission Assurance Workshop session that was part of a Code T Lessons Learned Workshop at MSFC. Members of the workshop developed 14 general lessons learned based on 35 comments initially identified. The information will be utilized by the Code T lessons learned development team who will also give feedback to the members of the workshop. Themes included the importance of establishing clear verifiable requirements and stressed the need for the early evolvement of S&MA with a full program role and an effective safety review process.

SSE prepared the draft update of MSFC 1700.2B, *System Safety Program,* and has been submitted to the MSFC Directives System for a two-week Center level review. After the closure of the review period, any submitted comments will be dispositioned and the final revision prepared for release.
SSE prepared the response the Dr. Know Question (363): "Is there a process for identifying Project/Program Safety Hazards and documenting them as Safety Risk?" Response outlined NASA, MSFC, and S&MA requirements and processes.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

Reliability and Maintainability Engineering (R&ME) is supporting the ongoing studies of Heavy Lift Launch Vehicle configurations as part of the Exploration Task Team. For the various launch vehicle configurations being studied, estimates of Loss of Payload (LOP) are established using the FIRST model. R&ME is tasked to take the LOP numbers and determine the probability of Mission Success, which is modeled as the probability of successfully completing the number of launches needed to achieve the ETT Reference Mission (135 metric tons to LEO on an annual basis). R&ME also provided inputs and comments to Reliability and Maintainability sections of proposed HRLV requirements.

R&ME supported the IEA IPT by reviewing the IEA Crimp Pull Test Process Procedure submitted by L-3 Communications. The procedure lists the process for testing the crimps before and after each shift as well as the control charts for the statistical process control. R&ME found the document to be acceptable.

An issue was recognized at the meeting concerning the retirement (02/05) of the only qualified DCMA representative at LeBarge Cables where the IEA harnesses are being manufactured. There is a second DCMA representative at the facility being trained but there is a question as to whether one person can handle the workload associated with inspection of the thousands of solders and crimps that are associated with fabrication of the Aft and Forward IEA harnesses.

R&ME attended and participated at the Project Constellation Pre-POP Workshop sponsored by the Exploration Task Team (ETT) Systems Integration Team (SIT). The purpose of the workshop was to develop the FY05 to FY10 manpower inputs, and supporting rationale, in support of Code T exploration transportation systems effort. SIT invited representatives from several Department of Defense programs that have implemented the Integrated Product Team (IPT) methodology. These individuals conveyed a good deal of information concerning the strengths and weaknesses of the IPT approach. SIT is tentatively attempting to implement IPT structure within the Constellation program. It appears that SIT will require representation on each team in order to integrate their products.

R&ME estimated reliability for KT Engineering Heavy Lift (45,000 kg payload) Concept for Exploration Task Team (ETT). The KT Engineering concept has 4 stages using 32 simple pressure fed liquid Methane/LOX aerospike engines and 4 SRB derived strap-on boosters. The main engines operate at ~80% thrust providing substantial engine out capability. This results in a projected LOP reliability of 1 in 198 (50% confidence), with a LOM (for delivery of 135,000 kg to LEO) of 1 in 66.

R&ME attended and participated at the Organizational Discipline Team Workshop VI. The focus of this workshop (Building a Program Uncertainty Database) was to gather information about previous programs that had challenges similar to the ones facing the Exploration Initiative. The organization team is currently building a database of time and workforce, to achieve program milestones and specific tasks. This data is being used to develop uncertainty distributions for a model to evaluate program risk. Particular interest was the analytic support for the development of the generic risk index algorithm to be used with a MS Project schedule and how to prepare team charts for conveying the essence of Organizational Discipline Team findings over the past year.

R&ME created a fault tree representing the JIMO Brayton Power Conversion System to support the JIMO System Level Fault Tree Task. Progress was also made gathering information on the JIMO design upgrades to the (Attitude and Articulation Control) AACS and the telecom systems Fault Trees. The upgrades are need for the JIMO programs Technical Baseline Review 2 (TBR2). This particular review is scheduled to begin in the June-July time frame.

R&ME supported the ASA test set validation conducted at Cincinnati Electronics (CE) 05/17/04 through 05/19/04. The testing was performed using an automated test set. The test set was originally created to test the Clifton ASA and was later modified for use on the CE ASA. The automated tests are limited to analog accuracy, analog linearity, discrete switch-point accuracy and static hysteresis. The 10SPC-0242 requires switch-point and analog output accuracy testing be performed at 4 psia/min rate. Manual tests include output impedance, isolation resistance, continuity and analog output load test. The testing was completed and no anomalies were identified with the test set. All of the data was reviewed and fell within the defined parameters. The CE ASA is currently scheduled to fly on BI-124 left.

R&ME supported the Space Vehicle Assurance Group/QS21 by reviewing ECP's and CR's in relation to the SRBE (Solid Rocket Booster Element) for impacts to the FMEA (Failure Mode Effects Analysis) and CIL (Critical Items List). R&ME supported QD20 by participating in a launch simulation (S00044 SIM) held at the Huntsville Operations Support Center (HOSC). The simulation went smoothly with no SRB or RSRM anomalies encountered.

R&ME participated in the NASA sponsored Seven Axioms of Good Engineering (SAGE) course given at the Marshall Institute 05/19/04 through 05/21/04. The course was designed to help engineers understand the role of lessons learned in critical thinking, the design process, and how to avoid classical design errors. Critical analysis of case studies was used as a practical method for impacting non-numerical engineering knowledge and skills to engineers. During the class, participants reviewed NASA and other case studies to determine some of the axioms of good design. Valuable points gained were how to identify the common characteristics of design failures and techniques for avoiding them by analyzing historical failures both within the space program as well as cases from other areas of technology.

R&ME completed the initial draft of the System Fault Tree for the JIMO project and provided it to Jet Propulsion Laboratory (JPL) for review. The System Fault Tree utilizes a top down System level approach identifying interactions and interfaces between different subsystems.

The Systems Analysis Project team has been selected as one of the 2004 NASA 'Turning Goals Into Reality (TGIR)' award winners. Also prepared and submitted were seven [7] NGLT lessons learned in the areas of: S & MA, Life Cycle Analysis and Organization Discipline Team.

R&ME participated in the PRACA re-write teleconference in order to review MSFC's rough order of magnitude (ROM) impact estimates of the 05/06/04 NSTS 08126 revision. Additional teleconferences have been scheduled throughout the end of May in order to complete the CR effort and to come to agreement on the work. R&ME has also routed PRACA item #A17835 / DRD4-5/338 (Nozzle Flex Boot Rubber Ply Separation) for review and signature in order to close this issue in the PRACA System.

R&ME participated in the final review of the Solid Rocket Booster Altitude Switch Assembly (ASA) qualification program before it is presented to the SRB chief engineer and project management. The review, a technical overview of the new ASA, listed the technical challenges throughout the history of the program. An issue that has been well documented throughout the history of the program concerning the soldering of the sensor performed by SNECMA (French Company) was documented and explained to the appropriate personnel who will be reviewing the Certificate of Qualification (COQ) package. The problem report history was also provided allowing for any concerns to be voiced early in the process. The SRB Project office expects the hard copy COQ with signature sheet to arrive at the end of the month. R&ME has been actively involved in the new ASA program since the Critical Design Review and believes everything is in order to facilitate the review.

R&ME participated in the SRB Enhanced Launch Vehicle Imaging System (ELVIS) Preliminary Requirements Review (PRR) the week of April 20 - 22. While the requirements could not be completely finalized due to the ELVIS specification awaiting final Level II approval, the majority of the requirements were reviewed and accepted. The verification matrix was reviewed with Review Item Discrepancies (RIDs) being submitted for Qualification criteria (analysis to test) and imagery requirements. S&MA was unable to review the preliminary FMEA/CILs and Hazards Analysis due to the design and requirements not being finalized. S&MA did question, and was assured, that potential debris sources would be the only Critical 1 failure modes to be added by the SRB Camera System. Additionally, S&MA was assured that all FMEA/CILs and Hazards Analysis would be performed to NSTS 22206 and NSTS 22254 respectively. Any Criticality 1 failure modes and Problem Reporting and Corrective Action would also be subjected to NSTS 5300.4 (1D-2) requirements as well as NSTS 08126. The ELVIS Preliminary Design Review is currently scheduled for the last week of May, 2004.

R&ME provided an update presentation to Senior S&MA management on the ongoing RSRM Stiffener Ring/Stub Corrosion Issue. Additional areas of corrosion continue to be discovered/identified during inspections of the ongoing corrosion investigation of motor case hardware. Efforts continue to evaluate this issue so as to determine if there is an impact to flight hardware. This meeting time has been scheduled as a weekly opportunity to brief and status Senior S&MA management of new and ongoing issues on the RSRM.

R&ME participated in the 5/5/04 SSP R&M Panel teleconference. This teleconference focus was to review/discuss JSC Trending & Data Mining activities. The presentation explained the use of statistical methods to summarize a given historical record in deciding if some phenomenon is increasing, stabilizing, or becoming less pronounced over time-can then be used to forecast events likely to occur in the future.

R&ME supported the IEA IPT Upgrades project by reviewing the SE-019-019-2H (SRB Master Verification Plan) on configuration matters. There are currently two issues regarding configuration for the IEA Harness Upgrade. Due to discrepancies concerning discontinuous nickel plating on two wire types, L-3 Communications has asked to use wire procured in 1990 to be used for Aft IEA Qualification Harness build. The wire, in stock, is from the same manufacturer, manufacturing to the same processes as the discrepant wire, and has been used for IEA rework from the time of procurement. MSFC Labs and SRB Project Office assured S&MA that there was no difference between the two lots and no configuration issue existed. Flight harnesses will be built with new, compliant wire. An issue being worked concurrently to discrepant wire issued concerns the tinning of the wire prior to solder operations. L-3 currently has procedures in place that call for tinning of the wire twenty times prior to solder operations. The excessive tinning was noticed during a critical process review held at LeBarge the week of 01/26/04. To alleviate the requirement, MSFC labs and USA suggested a sample of tinning operations performed on each gauge wire consisting of 2x, 3x, 5x, 8x, and 20x passes to determine the optimum number of tinning operations performed. The samples are currently at an independent laboratory for cross sectioning with the results due May 14, 2004. S&MA again raised the question of configuration differences between the current Qualification Harness build (20x) tinning operations per solder operation (per L-3) and what could potentially become a reduced number for the flight harnesses. MSFC Project, MSFC Labs, USA, and L-3 are awaiting the report before making a final decision, but discussed the possibility of Class 1 change to be implemented ASAP pending the cross sectioning report. S&MA is following these developments closely and will status on a regular basis.

R&ME supported the Space Vehicle Assurance Group/QS21 by reviewing ECP's and CR's in relation to the SRBE (Solid Rocket Booster Element) for impacts to the FMEA (Failure Mode Effects Analysis) and CIL (Critical Items List).

R&ME supported the NSI/BC Delta CDR held at the Marshall Institute April 28 – 30, 2004. Documentation reviewed included all released drawings for Critical Process call-out and additional failure modes, preliminary FMEA/CIL, OMRSD, and the Source Inspection Plans (SIP) for the NSI, BC, and Energy Absorber Honeycomb. Five Review Item Discrepancies (RID's) were generated against retention rationale in the CIL and incorrect call-outs in the OMRSD. United Space Alliance (USA) has generated developer's comments which were accepted to begin the RID closure process.

In support of X-37, R&ME reviewed program documentation and provided feedback to changes necessary for ensuring traceability flows to proper allocations and requirements. Reviewed design submittal FMEA/CILs in support of the flight termination system (FTS). This was performed in order to ensure that there is compliance with DRs relative to reliability predictions. Reviewed the progress being made on developing revisions to FMEA/CILS for ensuring that proper classification for CIL items are being applied. Follow-up communications continue with DFRC personnel to ensure that CIL items covered by their hazard procedures are not being duplicated by Boeing at Huntington Beach, CA.

Discussions also took place with Huntington Beach reliability counterpart concerning the removal of these particular CIL items from Boeings' data base. Received directions from NASA to cease all contact with Boeing and subcontractors pending information to be released in program meeting held on 06/04.

R&ME participated in the 05/26/04 PRACA CR Tiger Team telecon to review and discuss revisions to NSTS 08126. The selected sections of NSTS 08126 for discussion on the agenda were sections 3.1 (Reporting Criteria and Reportable Problem Definition), 3.4 (Process Escapes), and 4.5 (Problem Disposition Authority). However most of the 2 hour plus teleconference was devoted to discussing section 3.1 and whether or not to keep 'Process Escapes' as PRACA reportable criteria. The decision was made to remove Process Escapes from section 3.1. JSC S&MA's plans are to officially release the current version (Revision J Update of NSTS 08126, "PROBLEM REPORTING AND CORRECTIVE ACTION (PRACA) SYSTEM REQUIREMENTS) for official impact and discussion at the Shuttle S&MA Panel and the PRCB scheduled for 06/24/04. This particular revision has been identified as an integrated change (CR S062082C) and is currently under evaluation by RSRM Reliability Engineering.

R&ME supported the ATK BSM PDR held at United Space Alliance (USA) the week of 05/24/04–05/28/04. ATK explained the methodology of how they plan to document all FMEA/CIL's for the CDR. A Review Item Discrepancy (RID) was generated against USA for a lack of system documentation FMEA/CIL's presented at the PDR.

R&ME along with other members of the MSFC RSRM S&MA group were able to tour several of ATK Thiokol's Promontory, UT work centers (i.e. nozzle, mix and cast, NDE, etc.) during the June 10 FSM-11 test firing visit. The purpose of the tour was to observe flight hardware, manufacturing processes and inspection operations that are involved in the build-up of four segment RSRMs. These tours concentrated on past change packages/requests, which had been evaluated earlier by S&MA for hazard, FMEA/CIL, and quality issues leading up to the FSM-11 test. Preliminary results indicate that the test fire was a success except for ply lifting that occurred in the aft exit cone (AEC).

R&ME has been informed by the ATK Thiokol PRACA Group that an initial notification is forthcoming regarding the ply-lifting incident which occurred in the Aft Exit Cone (AEC) during the FSM-11 test fire on June 10th. RSRM Reliability expects to receive this notification by week's end. Reliability Engineering has also been informed by ATK Thiokol PRACA that no PAS item is thought to be required, at this time, for the slow-cast/high viscosity and rise rate issue of RSRM-99B's aft segment. Instead this issue will be handled through the Material Review Board (MRB) system. However this issue remains under an ATK Thiokol UUEC Board of Investigation to determine the cause(s) of this issue.

R&ME reviewed and evaluated the following change requests; CR-S062260, Integrated System Hazard Analysis and Reporting; ECR-MP41-2195, Incorporate Manufacturer Name Change; CR-S062297, EME System Level Assessment; MPCP-0208, Automated Inductive Inspection System Implementation for Case Dome Hardware; ECP03713R2, PRM-1 Nozzle Change Package; MPCP0225, ODC Free Cleaning on PRM1 Nozzle Bond and AEC Assembly; CR-S062082C, Revision J Update of NSTS 08126, Problem Reporting and Corrective Action (PRACA) System Requirements. There were no impacts to the RSRM FMEA/CIL documentation and therefore all CR's were accepted as written.

R&ME participated in the June 29-30 & July 1, 2004 Space Shuttle Program (SSP) Data-Mining & Trending Workshop held at the NASA Marshall Institute in Huntsville AL. The purpose of the NASA-JSC sponsored workshop was to; understand the what's, where's, when's, how's and who's that are available for the data-mining and trending process for the SSP; develop a consistent data-mining and trending process for all SSP elements based on team synergy of NASA and Contractor team members and best practices from the industry and develop a roadmap for an effective, responsive, meaningful and easy to use data-mining and trending processes for key LRU and critical processes related to SSP hardware.

MSFC SRB QD20 Reliability accompanied the IPT to vendor Berk-Tek 06/28/04 – 06/30/04. The process visit was to view construction of nickel plated wire used in the IEA Upgrades program. Issues concerning the nickel plated wire purchased from Berk-Tek include nickel and silver oxides/sulfides found during Qualification harness build up and loss of original wire Qualification Data from original manufacture. The IPT viewed the entire process of manufacture from receiving of materials to final shipping product. The team, after reviewing the manufacturing procedures, brainstormed possible suspect areas of contamination and implemented the following corrective actions to wire extrusion manufacture: 1) Replace/clean wire pullys after each wire run; 2) Institute cleaning schedule procedure for guide tube; 3) Replace guide tube tip after each wire run; 4) Install filter on shop air used for drying purposes; 5) Implement procedure for initial wire cleaning from vendor; and, 6) Implement better housekeeping procedure for manufacturing line. The IPT believes the corrective actions will eliminate potential debris sources during manufacturing and produce wire to meet the NASA/MSFC 40M39513 and 40M39526 specifications. The loss of original Qualification data will be remedied by a Quality Process audit.

SRB QD20 Reliability participated in a PDR held 06/22/04 – 06/25/04 at United Space Alliance (USA) Huntsville. A thorough presentation was given by USA to all participating PDR members and teams were coordinated and separated to perform independent reviews of the documentation provided. MSFC SRB S&MA reviewed all applicable drawings, processes, verification, FMEA/CIL's, and HA for RID generation. RID's were written against a lack of Criticality 1 and 3 failure modes for the camera system. USA SR&QA Engineering expects to have the FMEA's, CIL's , HA, and Qualification Plan 95-100% complete by CDR as the design becomes finalized.

ET R&ME continued to participate in meetings regarding current and future plans for sub-scale material tests. Category 3 tests continue to be conducted at the MSFC. At this time, the Cabot Nanogel Beads and scrim cloth barrier is the selected configuration for higher definition tests. ET RE supported meetings this week outlining various actions that need to be worked prior to Cat 1 and Cat 2 testing, including participating in a process FMEA (P-FMEA) preparation meeting for the BX-265 spray and the PDL. ET RE also witnessed the driplip verification spray. Final data approval and checklist verification prior to the V & V kickoff is underway at this time.

ET Reliability Engineering (RE) continued to participate in meetings regarding the ET RTF camera. The use of quartz (fused silica) or sapphire disc is now being evaluated to replace the Lexan™ in the protective cover. A separate evaluation is being conducted to re-determine the possibility of flying without the protective cover. ET RE reviewed and signed a test plan and test procedures for the battery tests at MSFC and concurred for test initiation at the Test Readiness Review (TRR). ET RE also reviewed and approved several different Non-Conformance Documents (NCDs) related to the camera system. All were minor discrepancies of the bracket hardware for the camera or the antenna. Confidence sprays for the antenna closeout were also satisfactorily conducted. ET RE witnessed part of the dissection. Approval was given to move to the validation portion and ET RE witnessed the actual sprays. Dissection is expected soon to determine the validation status. ET RE also reviewed and signed a 714 page test report. ET RE will continue to be involved in the test program and implementation of the ET camera.

ET Reliability Engineering (RE) also participated in meetings regarding the Instrumentation Team. Plans are being developed to evaluate the potential installation of additional instrumentation on the ET for data gathering only. The Instrumentation Tech Panel and the Instrumentation Team evaluated various options prior to finalizing STS-114 instrumentation selections. A decision was reached to put accelerometers inside the LO2 cable trays for PAL Ramp studies and to use the bipod web temp sensors to gather data during flight. ET RE coordinated the risk assessment with the appropriate LM Safety and Reliability personnel and incorporated the information into the Instrumentation presentation to the ICB and PRCB. ET RE also briefed S&MA management at MAF, JSC, MSFC, and KSC

4.2.2 Problem Assessment Center Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, coordinated the MSFC Problem Assessment System, supported various redesign and return-to-flight activities, participated in the STS-114 countdown simulations, assisted in Shuttle data mining and trending activities, and operated the Corrective Action System (CAS). The PAC received and entered 28 new problem report (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 19 PRs, received 18 prime contractor closure recommendations, supported MSFC full closure of 13 PRs, coordinated non-problem closure of 10 problems, and performed 240 individual PR database updates and reviews. PAC conducted 5 SSME problem review boards (PRBs) resulting in dispositioning 33 of 33 problem reports presented, initiating storage of supporting data on a common-access server. The PAC generated or updated trends for MSFC Shuttle problems submitted as newly opened or for closure. PAC also generated and distributed monthly problem bubble trend risk charts and briefed the charts at the monthly SRB Problem Assessment System (PAS) review. PAC reviewed 31 requests for access to the MSFC PRACA database (mostly from NESC personnel) and granted all of them.

In support of return-to-flight, PAC coordinated MSFC's review and impact of proposed changes S062082B and S062082C to NSTS 08126, Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements. This included participating in 8 Rewrite Tiger Team teleconferences, coordinating MSFC Shuttle and prime contractor participation in them, and circulating results of the meetings. It also included evaluating the proposed changes, circulating these evaluations among MSFC-related participants, reviewing and discussing contractor-submitted evaluations and recommendations, and presenting evaluations at the meetings. All of these activities were coordinated by the PAC with the various MSFC Shuttle Project Offices, S&MA Shuttle Integration, and the MSFC Shuttle prime hardware contractors. PAC also performed SSME Data Mining for Periodic/Episodic/Repeating Problems, coordinated the Marshall-hosted SSP Data Mining and Trending (DM&T) Conference, and provided data and explanation support on MSFc PRACA and webPCASS to the NESC DM&T review activity.

In problem system coordination, the PAC conducted 3 SRB Problem Assessment System (PAS) status reviews for the SRB Chief Engineer and provided estimates for development of Constellation PRACA requirements.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT activities and status reports, and quarterly Open Problems List (OPL). Special activities included: (1) providing a complete list of MSFC PRACA SRB problem reports for USA-SRB's use in data mining; (2) extracting, formatting, and providing SSME problem histories on top 12 KSC PRs and RKDN IDCRs from 1999 thru 2003, nozzle jacket creases/cracks/ bulges/Uralite repairs, P&W HPOTP G3/G6 issues, side load arrestor mechanisms (SLAMs) at Stennis, and controllers F41/F42/F54/F60; (3) providing ET problem data on locking fasteners, GO2/GH2 vent/relief valve position indicators, and foam loss; and (4) extracting and providing numerous KSC PRACA problem reports.

In problem trending, PAC generated regular problem entry and disposition problem histories; issued monthly bubble trend charts with interpretations of data; and provided, explained, and answered questions and offered advice/suggestions regarding MSFC and general Shuttle trending to NESC representatives.

(PWS 6.3.3) In implementation and operation of the MSFC Corrective Action System (CAS), PAC received 36 potential CAS reports, screened 37 draft Recurrence Control Action Requests, elevated 6 to new Recurrence Control Action Requests (RCARs), coordinated 9 point of contact (POC) responses, and

facilitated 2 Corrective Action Boards (CABs). PAC also provided and discussed CAS metrics and open RCAR status reports at Marshall Management System (MMS) Implementation Team meetings, and issued monthly RCAR status and delinquent response reports. PAC briefed the Marshall Quality Council on CAS activities, provided data to the monthly S&MA Management Status Reviews, and supported the NQA's audit of Marshall to ISO 9001:2000 and AS9100.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as HEI coordinated MSFC ALERT processing and participated in the NASA and general Government-Industry Data Exchange Program (GIDEP) activities. HEI received and distributed 34 ALERT announcements for MSFC review and obtained 1457 responses from MSFC project, contractor, and laboratory contacts. HEI also provided notification, assistance, and support contributing to reducing the delinquent ALERT response count from 323 on 3/31/2004 to 121 on 5/31/2004. HEI ALERT support personnel 1) reviewed 10 and approved 9 new MSFC ALERT database accounts via the TPS security; 2) generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; (3) recommended revision to NASA NPR 8735.1 to limit time a Center can delay in issuing a NASA advisory; (4) assisted processing of ALERTs by the MSFC projects and directorates; (5) coordinated revision of ED's ALERT review and response organization; (6) enhanced the ALERT software to provide fuller information in the initial announcement of ALERTs; (7) assisted in conducting the GIDEP workshop in Philadelphia; and (8) began serving as GIDEP Industry Advisory Group Chairman for 2004-2005.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering (QE) participated in debris impact Systems Engineering and Integration Technical Interchange Meetings associated with element debris impact testing. QE also participated in an AL 2297 Thrust Panel TIM to discuss recent failures of fracture property tests of the AL 2297 production lots. QE participated in re-write meetings of NSTS 08126, Problem Reporting and Corrective Action System Requirements. The re-write results from a PRCB-directed action. QE continued to review numerous test plans and procedures and participated in Test Readiness Reviews for development and certification tests conducted for Return to Flight (RTF) activities. In addition, QE continued day-to-day activities which included participating in the monthly Quality Escape telecoms and preparing the Quality Escape Reports, participating in the ET Thermal Protection System Working Group, participating in Composite Nose Cone team meetings and participating in the Space Shuttle Program Quality Panel.

Solid Rocket Booster (SRB) QE continued to review numerous test plans and procedures for certification tests conducted for RTF activities. In addition, SRB QE continued day-to-day activities which included support to weekly Booster Separation Motors (BSM) Integrated Process Team (IPT) meetings, BSM Plume Characterization Team, Return to Flight (RTF) Action Review, and RTF Technical Interchange Meetings (TIM).

SRB QE continued to support the BSM graphite cracked throat crack tiger team meetings. QE supported the development of the new bondline evaluation procedures and reviewed progress of the Factor of Safety (FOS) and the material properties analysis as it developed. QE supported the BSM Phase III acceptance reviews covering all hardware and paperwork related to this activity.

SRB Pyrotechnic QE provided weekly S&MA support to the MSFC-USA pyrotechnic working group and Confined Detonating Fuse Assembly (CDFA)/CDF Manifold second source supplier meetings. QE provided technical assessment of Class I design changes and Class II design/manufacturing/test

requirement changes. QE continued to provide quality expertise for the T- Manifold Device design development activities (part of the proposed Holddown Stud Ejection Assist System), NASA Standard Initiator Pressure Cartridge (NSI-PC) redesign qualification test requirement and procedure documentation preparation activities, CDF Manifold dissimilar metals technical assessment, preparation and maintenance of pyrotechnic hardware Technical Issues Briefings to S&MA management, and CDF Initiator output charge redesign development activities. QE represented QD20 during the Lot ACG SRB 17 Second Delay Cutter Phase III Review, the Separation Bolt Test and Analysis Technical Interchange Meeting, the determination of inspection requirements and subsequent physical inspection at KSC of pyrotechnic components removed from SRB assemblies, Lot ABD NSI-PC pre-shipment incremental Phase III Review, and the Lot ABS BSM igniter retrofit Phase III Review.

QE evaluated results of the first BSM Redesigned Igniter Qualification Motor firing. Data for the redesigned igniter and motor pressure vs. time traces were nominal with no erratic pressure. QE supported General Products Incorporated Bolt Catcher Critical Design Review. QE participated in the Booster Separation Motor weekly Plume Characterization and ADAPTS team meetings.

Space Shuttle Main Engine (SSME) QE participated in the investigation of contamination discovered on OV-104 Orbiter Main Propulsion System. Contamination was found at the pre-valve screen and was recurring with each inspection. SSME QE worked with MSFC and JSC personnel to develop a system logic probability study quantifying the risk to the engine due to a worst case contamination environment. Waivers to the contamination were accepted at the PRCB for one flight. QE participated in two technical interchange meetings (TIM). QE continued to support the flowliner crack investigation and test program. QE served on the SSME chief engineer's return to flight (RTF) CE-1 and CE-3 teams.

SSME QE acted as lead in auditing the SSME design change implementation process for areas of improvement. The investigation focused on developing tools to expedite changes which do not have a specific affectivity. The audit produced 9 areas where processes are being improved to provide greater NASA control and insight into the implementation of safety related design improvements.

Reusable Solid Rocket Motor (RSRM) QE reviewed engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. QE has continued to act as the S&MA main point of contact for the RSRM Propellant Structural Analysis issues and pending waiver, liner bubbling issues, and the Propellant Slow Cast UUEC investigation. During this quarter, RSRM QE continued to act as the S&MA point of contact for the propellant, liner, and insulation work centers and to lead weekly reviews of Thiokol's corrective actions. Also QE traveled to Thiokol to support the quarterly RSRM S&MA review and the static test firing of FSM-11.

QS20/QS40 QE supported the NASA Workmanship Technical Committee by participating in several telecoms and meetings. QE participated in several telecoms with Joint Group on Pollution Prevention's (JG-PP) Lead Free Solder Project for QS20. QE participated in Shuttle Assurance Technical Team reviews and supported the Preliminary Design Review on SRB Camera Systems.

Software Quality Assurance (SQA)

Software Quality Assurance (SQA) participated in four formal document reviews for Orbital Express (OE). These include: Software Requirements Specification (SRS) Plan, Software Development Plan (SDP), Software Configuration (SCM) Plan, and the Software Quality Assurance (SQA) Plan. SA wrote the SQAP for OE. SA participated in the OE Preliminary Design Review (PDR). SA conducted 3 audits for the OE program. These include the audit for SCM, SRS and SDP.

SQA completed the Software System Safety training course presented by the NASA Safety Training Center, Continuous Risk Management (CRM) Training and IEEE 12207 Training. SQA participated in QD40 staff meetings and monthly status reviews with S&MA management.

SQA participated in X-37 Software Configuration Control Board (SCCB) Meetings, Technical Review Board (TRB) Meetings, Risk Management Meetings and various In-Process Technical Reviews (IPTR). These IPTRs include: Vehicle Management System (VMS) and Flight Management System (FMS) test procedures and SRSs.

ISO/AS9100

QE has continued to play a key role in ensuring the maintenance of ISO 9001 and AS9100 at MSFC during this time period. Efforts have dealt with continuing implementation of ISO 9001 and AS9100, maintenance of documentation (including the revision of two documents), and planning and support for the second triennial NQA registrar audit, including preparation of self-assessment checklists for the MSFC organizations, escorting, development of corrective action plans, and follow-up of corrective actions. QE provided general ISO and AS9100 support, including reviews of both MSFC and NASA Agency documentation and consulting support on internal audits, records, document control, and other aspects of ISO 9001 and AS9100, to various MSFC Organizations. QE also participated in a NASA Agency Quarterly Quality System Status Review meeting at the NASA Independent Verification and Validation (IV&V) Facility.

Payloads

QE performed drawing reviews, procedure reviews, test readiness review, and procurement reviews, inspection requirements, shipping requirements, and supported team meetings for MPLM, BiC, BRP, EGN, TES, OPCGA, Delta-L, ECLSS, QMI, SHIVA, GBM, MSRR, GP-B, Solar-B, MSG and GEDS. QE reviewed and provided comments for safety verification closures for OPCGA, TES, Delta- L and ECLSS. QE provided quality expertise to Material Review Boards for ECLSS, MSRR, g-LIMIT and MSG. QE provided support for the Gravity Probe-B (GP-B) Project by participating in a Flight Readiness Review (FRR).

QE reviewed MSFC Custodianship Procedures, schedules and agendas for the MSRR MSL Engineering Model (EM) and participated in meetings and telecoms held with ESA. QE reviewed and commented to submittals of the Acceptance Data Package (ADP) for the Wastewater Storage Tank Assembly (WSTA) book I & II for Environmental Control and Life Support (ECLSS).

QE reviewed flight flex hose and flight cable ADP for Material Science Research Rack (MSRR). QE worked to resolve the fastener issue for the Material Science Research Rack (MSRR) Project on the use of flight fasteners for the rack.

QE conducted a quality review of the SOLAR-B Extreme Ultraviolet Imaging Spectrometer (EIS) ADP to determine if the QA controls/documentation included in the Pre-Ship/Acceptance package was adequate.

QE reviewed GP-B ADP at Stanford University in Palo Alto CA, Lockheed Martin in Sunnyvale, CA and Vandenberg Air Force Base (VAFB) in Lompoc, CaA

QE reviewed the PRACA notification report for the anomalies that occurred during system level testing on the WPA for ECLSS.

QE participated in the preparation and review of the ADP for the 2nd flight set of Programmable Thermostats (PT) and Data Recording Module (DRM) for the MPLM project team.

QE provided inputs and assisted in the preparation and review of the Shelving Plan for the Delta-L hardware. The Phase II and III Ground Safety Data Packages were reviewed by QE and comments provided to the Delta-L project team.

QE participated in the preparation and review of the ICD for the GEDS Thermal Probe. In addition, Quality Engineering participated in the review of the GEDS toxicity discussions and ways to mitigate the toxicity concerns for the experiment. QE provided review comments for all GEDS Engineering Change Proposals and participated in Configuration Change Board approvals.

QE attended the Technical Interface Meeting (TIM) held at Ames Research Center for the Thermal Protection System for the Wing Leading Edge on the X-37. Quality Engineering also participated in the X-37 Tiger Team that was established to expedite the buyoff and installation of the Power Control Distribution Unit into the X-37 vehicle.

QE supported the recertification of the MSG and the recertification TIM with the PSRP.

QE conducted a Functional Configuration Audit (FCA) of the ECLSS Water Processor Assembly (WPA) at Hamilton Sundstrand in Windsor Locks, CT.

QE performed a number of activities associated with the start-up of the SUBSA/ Olsen experiment on the International Space Station (ISS).

QE supported the JWST Primary Mirror Segment Assemblies (PMSA) Vacuum Cryogenic Test Facility Requirements and Concept Review.

QE performed a Quality Review of procedures and facilities for SOLAR-B at the Mullard Space Sciences Laboratories in Peaslake, England and at the Rutherford Laboratories in Didcot, England.

Inspection and Test

Quality Assurance (QA) supported OPB Igniter Spark Check Test at Test Cell 103. These tests were conducted to verify Paschens curve (pressure versus voltage) for the O2 for this spark gap and plug configuration using a variable, high voltage exciter.

QA personnel monitored the testing of the 11" motor fitted with fiber optic instrumentation.

QA supported testing of various panels in support of Return to Flight activities. These test were, hot gas testing of conathane 15069 pot life issues, hot gas testing of MCC-1 thermal verification test, hot gas testing of thermal and dynamic qualification of machined cork and hot gas testing of hypalon/acrymax compatibility testing.

QA personnel monitored test activities during the KT Engineering (KTE) test series at TS-500.

QA personnel performed visual weld inspections and non-destructive evaluations on an as-needed basis during build-up of numerous programs in the test areas. These programs include the 24-inch motor High Pressure Grain Test at Test Stand 500, the Multi-Purpose Hydrogen Test Bed Liquid Nitrogen test at Test Stand 300, the 11-inch Hybrid Motor case hardware at Test Cell 103, and the facility fuel system leak check troubleshooting operations at Test Stand 115.

Test Area QE reviewed, revised and released procedures for the test facility build up and the testing of the Northrop Grumman composite tank. QE was part of the National Quality Assurance (NQA) audit for the

Northrop Grumman composite tank. QE presented the QA Test Readiness Review charts for the cold flow hydrogen rig to support LAI investigation.

QA Inspection received and inspected various items of hardware for Urine Processing Assembly (UPA), Material Science Research Rack, and Glast Burst Monitor. Part tags were issued to all items accepted.

QA monitored Acceptance Test of the MSRR-1 Power Control Rack. Unit passed the test.

QA monitored Acceptance and Qualification Test for External Camera Batteries. Functional tests were performed on 12 each battery packs. All units passed the test.

QA monitored the vibration testing of bolt catcher machined cork test panels per Procedure: SRB-QUAL-04-017 and SRB-QUAL-04-054.

QA personnel monitored the modal testing of the Orbital Boom Sensor System Manipulator Positioning Mechanism per OBSS-DEV-04-22.

4.4 Information Management (IM)

During the quarter, Information Management (IM) provided updates to the Environmental Health module and released the Environmental Module of the Safety, Health and Environmental Tracking (SHEtrak) application to production following a lengthy test and modification period that resulted in drastically revised requirements. An on-line user guide was provided, and Safety Search was revised to incorporate Environmental Management data. SHEtrak was also modified to interface with the Inventory of Hazardous Operations (IHOPs) application and provide inspectors with hazardous operations information for a selected building. The Internal Quality Audit (IQA) application was beta tested and numerous additional functions and reports were completed. IQA development is now frozen for completion of an Operational Readiness Review (ORR) and deployment. A revised S&MA web site structure and layout was developed, approved, partially populated, and demonstrated for QD01. Requested modifications were incorporated and departmental sites were populated with known data. IM completed a web form to automate collections and management of quarterly Continuous Risk Management status data and functionality to update the class schedule. IM also assisted Advanced Projects in selecting a tool and populating a database of requirements information in support of a NASA headquarters initiative.

Numerous applications were modified during the reporting period. The Building application and Point of Contact page were revised to display multiple assistant building managers and Facilities Project Managers. A module that allows inspectors to view hazardous operations details and completed checklists for a selected building was created for the IHOPs application. Safety Search was modified to provide details regarding Facilities Work Order status for facilities inspection findings. The Audited Vendor List (AVL) application was modified to allow edit of the reason for removal of Suppliers and to provide for an additional field. The additional field modification was provided within a day due to a quick turn-around request by the Curator. The As-Built Configuration Status System (ABCSS) was revised to include the install date as search criteria in the As-Built/As-Designed Report. The Travel application was modified to provide for the revised S&MA organizational structure. The ALERTs application was revised to provide additional information on issuance. Functionality was developed to provide personnel with appropriate privileges to upload specific documents, such as organization charts, to a web site, resulting in increased efficiency. Other functionality was developed to restrict access by page through a specific file of IP addresses.

IM supported an ORR at NASA Headquarters for the NASA-wide replacement Incident Reporting Information System (IRIS) application. The ORR resulted in eventual acceptance of the application for deployment. QD's primary server administrator received a National Agency Check (NAC) and met

minimum requirements for private access. The backup server administrator successfully completed certification in MS Windows 2000 Server Administration and Network and Internet Security, meeting the agency's June 1st deadline for certification. In support of the Information Technology Manager (ITM), IM provided FY05 updates to the IT Master Plan; input for and updates to the IT and IT Security Pop Calls; update to AOAs; and comments on numerous document revisions. IM personnel also attended the Data-Mining and Trending Workshop, an NESC Recurring Anomalies Kick-off Meeting, and a Windows XP Professional course to improve support of associated tasks. Significant support was also provided to the UNITES contract in setting up an organization of over 1100 employees, including establishment of approximately 70 groups.

4.5 Human Exploration and Development of Space (HEDS) Assurance

At the request of the Center Director, an assessment of Automatic External Defibrillators (AED) deployment and training at MSFC was performed (MH 4005). Meetings were held with Medical Center personnel as well as with MSFC personnel who had received AED training. IA performed a site survey of AEDs located across MSFC. An Out-briefing report of this assessment has been completed and submitted.

4.5.1 International Space Station (ISS) Independent Assurance

The final report of the International Space Station Safety and Mission Assurance Certification of Flight Readiness (COFR) Review Process (IA-JKM-3002) has been released.

MSFC IA participated in a two day International Space Station Program Quality Assurance Technical Interchange Meeting at KSC. The ISSP Safety, Reliability, and Quality Assurance (Code OE) maintains Letters of Delegation (LOD) for Defense Contract Management Agency (DCMA) personnel across the US and Italy (i.e., Alenia) that support ISS QA activities. The NASA management of Code OE schedules and conducts TIMs to discuss activities such as the health of the ISS QA Program, Code OE Program level activities, projected manpower, work loads, and projected hardware milestones. Engineering Information Report TW-4003 was generated to document the TIM activities.

MSFC Independent Assessment personnel participated in the MSFC ISS Quarterly Review. Multiple presentations which defined the accomplishments/status (including significant milestones) for the MSFC managed ISS hardware (Nodes 2 and 3, and ECLSS) were provided to the NASA community present (MSFC, JSC, KSC, HQ, etc.). The MSFC Nodes Project Office is being restructured and will move the Nodes Project Office and Design Center to JSC. The Nodes Integration Office will be at MSFC. Activities are presently being worked for these office transitions.

4.5.2 Space Shuttle Independent Assurance

MSFC Independent Assessment developed and submitted an Engineering Information Report, (RM-4005) encompassing IA participation in the Critical Design Review (CDR) and subsequent Delta Critical Design Review (DCDR) for the Bipod Redesign at the MAF.

IA continues with the Independent Assessment of SSP RTF Actions SSP-4 (Accepted Risk Hazards) and SSP-9 (Failure Mode & Effects Analyses/Critical Items Lists) JKM-4001. IA continued to track the progress of the review of the subject SSME HR's and FEMA/CILS by Pratt & Whitney and Rocketdyne. This assessment was initiated to address the "CAIB Findings, Recommendations, & Observations". One step of this assessment was an interview of the review personnel to assure that they are following the proper procedures, have the appropriate expertise, and that the review is thorough and timely. IA conducted this interview with Boeing and HEI personnel that are intimately involved with the review process. After a thorough review, IA assessed that the proper procedures are being followed, the expertise

is sufficient, and their review is proceeding toward a timely completion date that will support Shuttle RTF. The SSME portion of the assessment will be integrated into the total SSP Project and Element review by JSC, KSC, & MSFC.

IA participated in a TIM which was held to evaluate the data generated to design the Solid Rocket Booster Boltcatcher energy absorber. Extensive testing was conducted to measure the acceleration characteristics of both ends of the ET attach bolts during separation. These data were utilized to derive the energy absorption requirements for the foam receptors and compared to the capability of the foam to assure containment of the frangible bolt components. The acceleration test data also served to anchor the analytical models which predict pressure and acceleration resulting in the improved ability to predict dynamic conditions during pyrotechnic bolt separation. Approximately 40 people were in attendance representing the technical communities from the SRB project office, the MSFC Engineering and Safety and Mission Assurance Departments and the USA prime contractor.

Independent Assessment (IA) continued to track and evaluate the progress of the Space Shuttle Main Engine (SSME) Liquid Air Insulation testing at MSFC. This testing is in response to a need to increase the insulation around certain areas of the SSME High Pressure Fuel Turbo pump (HPFTP) to prevent the formation of liquid air that could possibly drip onto and affect the reliability of pump sensors. Tests #2 and #3 have been completed. The second test, conducted on May 10, 2004 was planned for one hour after a facility/pump chill-down. Fifteen (15) minutes into the test, a leak from the area of an 8 inch valve was noticed and the test was terminated. The valve was removed and sent to the valve lab for examination. The valve was reinstalled and Test #3 was completed on May 19, 2004. This test utilized helium bags to isolate the cold areas that had produced LN2 in the past. There was no indication of LN2 formation anytime during the 8 hour test. One additional benefit observed from this test was that the entire test rig was thermally stable after 3 hours. Future tests will be scheduled for 3 hours.

IA participated in the Bolt catcher-NASA Standard Initiator (BC-NSI) Delta Critical Design Review (CDR) Pre-board on May 19, 2004. 36 RIDs including 30 BC and 16 NSI RIDs, and 35 Actions (32 BC and 3 NSI) were generated by the Delta CDR team. All of these RIDs and Actions were closed or received verbal concurrence for closure from the initiators at the time they were presented to the Pre-board. The Pre-board concurred in the results and adequacy of the BC-NSI redesign and plans for qualification, but due to an unconventional approach and identified risk associated with the approach to verification of the NSI pressure cartridge 1.7 factor of safety and adhesive plugs used to fill the bolthead cavities of the BC-NSI attach bolts as a potential debris source, two RIDs were recommended to be presented to the Board. All issues raised by IA personnel have been addressed.

IA participated in and evaluated the SSME project discussion of a metallic particle of contamination discovered during the inspection of the SSME HPOTP 8025 which was last used on Engine 2050. Physical measurement, optical examination and fractural and material analyses were performed on the particle. The material was determined to be CRES 316, a stainless steel which matched injector heat shield retainers. There is a history of contamination from these retainers and they are difficult to examine because of their location. Further disassembly is planned to determine the exact source of this particle.

The ongoing independent assessment (MH4001) of the Lockheed Martin (LM) Michoud Procurement process will determine LM's capability to ensure that only acceptable hardware/materials enter ET production. The IA Team reviewed LM procurement data, including performing desktop assessments, contacted MSFC S&MA personnel for LM procurement audit reports/surveys etc., and are in the process of selecting a small number of LM prime suppliers for assessment of procurement requirements flow down. Schedules are being established for additional interviews, and field observations of the LM MAF and LM prime suppliers.

The assessment of KSC GSE that Interfaces with SSP Flight Elements Out-Briefing Presentation was completed and presented to the SSP Program Manager at JSC by the Team members on June 15, 2004. The briefing was also attended by the Deputy SSP Program Manager and personnel form the Orbiter Project, Space Shuttle Engineering Integration, S&MA/IA, several active and inactive Astronauts, and various other SSP Support personnel. Personnel at NASA Headquarters, KSC, and MSFC participated via teleconference. Actual umbilical hardware samples and demonstration models were used during the presentation to better demonstrate potential failure scenarios. The SSP Program Manager agreed with the IAT that evaluation of this assessment must be assigned Return to Flight (RTF) priority and will be accomplished via the PRCB. The Program Manager directed SSP Engineering Integration to take the lead in this evaluation due to the integrated nature of potential failure causes and countdown/launch environments. Final comments by the Program Manager and his staff indicated that this type IA assessment is greatly appreciated in identifying Safety of Flight concerns. The IA Team is currently working on the Final Report.

IA participated in a TIM on the RSRM "Nozzle Plylift Issues" at MSFC on June 14-15, 2004. This meeting was supported by the RSRM Project Office, MSFC Material, Processing & Manufacturing personnel, ATK Thiokol, and HEI. Nozzle plylift is the number one RSRM RTF issue. The plans presented will likely result in a much improved analytical model to predict plylift in solid rocket motor nozzles.

IA participated in a Space Shuttle RTF Status presentation by the Chief Engineers of each Shuttle element plus the integration group. Each one presented their "top" concerns and status. This presentation was top level only and did not intend to explain all the technical details nor cover all the items that are being addressed for RTF. The presentation was well received by MSFC Center Director and his staff, and he suggested that future status meetings be held monthly or bi-monthly, whenever needed.

4.5.3 Space Launch Initiative Independent Assurance

The Assessment of Demonstration of Autonomouos Rendezvous Technology (DART) Project has been completed. Discrepancy Reports (DR) (MH-4002) from the DART contractor (Orbital Sciences Corporation) were reviewed to evaluate contractor/project readiness for a Test Readiness Review and thermal vacuum testing, to assess technical rationale for disposition of DRs, and to assist the in-line S&MA in determining which DRs need further technical review. Verbal and written comments were supplied to the customer and indicated no "show stoppers" that prohibited the review or test. The draft report was revised to include all assessment team comments and the final report was approved by the MSFC IA Manager 04/12/04.

4.6 Project Assurance

During the reporting period, HEI Project Assurance (PA) provided a one half day presentation of Continuous Risk Management for the subject project with a follow on risk identification workshop scheduled. There were three participants locally in the class held at the Marshall Institute and three participating by teleconference at JSC, Goddard and Ames. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

PA refined Preliminary Hazard Analysis (PHA) for the Jupiter Icy Moon Orbiter (JIMO) refuel study. The PAE participated in the refuel study meeting discussions about the pros and cons of each option, along with other ideas as they came up. The PAE brought System Safety and Reliability personnel into the process to assist in the evaluation of Docking Mechanisms.

PA participated in conceptual discussions for the development of hazard and reliability analysis tools to support real-time concurrent conceptual engineering processes used by the PARSEC and Lunar Surface Power teams. The PAE attended meetings to discuss the development of these tools. The PAE has a

conceptual top-level idea of how to pull this tool together. The PAE has engaged System Safety and Reliability personnel to consider how they might develop their respective components of this tool.

HEI PA supported the Next Generation Launch Technology (NGLT) Shuttle Derived Study as the Lead Engineer for the In-Line concepts. Following a successful mid-term presentation of the NGLT Shuttle Derived Study, which was very well received, the team is now concentrating on finalizing the study.

HEI PA conducted an eight-hour Introduction to Continuous Risk Management Course: This course was conducted for a generic group project leads and engineers working at Marshall on NASA projects and programs. The S&MA/QS-40 CRM lead reviewed the material prior to instruction for content accuracy possible updates on the course.

HEI PA conducted a four-hour Executive Overview to Continuous Risk Management: This course was conducted for a generic group of project leads and engineers working at Marshall on projects and programs. This course provides a snapshot of CRM process to senior engineers and project managers.

HEI PA reviewed Integrated Risk Management Application (IRMA) Administrator's Guide Developed by Futron: Reviewed the Integrated Risk Management Application (IRMA) Administrator's Guide for accuracy of content and implementation among the IRMA community.

PA participated in initial meeting to transfer IRMA from Orbital Space Plane (OSP) to Safety and Mission Assurance Office (QS-40): The OSP Program Planning and Control Office has offered to donate risk management tools and resources (software, equipment and personnel) to Safety and Mission Assurance/QS-40 to support the CRM effort. The IRMA tool was offered to aid in the implementation of the CRM process in data collection and documentation. S&MA/QS-40 agreed to accept the resources and review the implementation of IRMA as a CRM tool.

The PAE developed a concept for a hazard and reliability analysis tool to support real-time concurrent conceptual engineering processes used by the PARSEC/Lunar Surface Power teams, other concurrent engineering efforts, and trade studies. The PAE developed a presentation to promote development of this tool concept.

The PAE participated in HyTEx brainstorming sessions for coming up with ways to maintain a low cost technology flight test bed program. The PAE proposed a concept for launching rockets from high altitude balloons. The PAE has experience with balloon launched rockets (rockoons). This concept would enable higher energy missions at a fraction of the cost of the previous HyTEx sounding rocket concepts. The rocket would be launched above most of the atmosphere about 20 miles up. It could be launched at a low angle of inclination which means it can go into cruise phase immediately after booster burnout. No pullout maneuver would be required. As the original concept required a 50 g pullout maneuver with high heat loads this could significantly reduce mission risk and improve experimental test quality. The PAE is currently developing a presentation on the concept and supporting the development of a Subproject white paper which is intended to respond to NASA's Exploration RFI.

PA supported the study, where Rocketdyne presented another Main Combustion Chamber (MCC) issue on the IPD Project, this one related to large grain size areas detected in the chamber liner. Increased grain size alone will not significantly impact performance and/or safety as the factors (yield & ultimate), although reduced, remain above accepted minimums. However, this condition, combined with Rocketdyne's decision to "proof test" to only 80% of the maximum power level (industry stds. 125-150%) and unwillingness to perform post- proof NDE, significantly increases the uncertainty factor and associated risks. Without post-proof NDE, verification of the integrity of the liner/chamber bondline

cannot be determined and should the liner come "unzipped" during test, the presence of irregular grain sized areas would accelerate propagation of the failure.

The IPD contract is Air Force managed with MSFC TD serving as the technical lead and S&MA limited to an advisory role with no authority to impose additional requirements. If NASA and DOD are to enter into such partnering arrangements in the future we should, based on "lessons learned" on IPD, insure that NASA/MSFC has the authority to implement additional requirements when weaknesses in the current requirements are identified.

The CRM brochure was developed by PA, at the request of the (QD40). It purpose is to promote CRM and the capabilities of the CRM support team to include: CRM training, assistance in developing risk management plans, risks lists and risk mitigation plans.

This ePORT training course was conducted by PA, for all the ISP key project personnel. It incorporated CRM theory that was covered in the morning CRM overview as well access to the database, data entry and sample reports.

PAE finalized the Shuttle Derived Study as the Lead Engineer for the In-Line concepts. The final presentation was made by the ETT management to Code T at NASA Headquarters on Wednesday, May 5, 2004. It was very well received. In addition, PAE supported the Human Rated Task which was finished on June 15, 2004.

The PAE developed a presentation on alternative (mostly commercial) approaches to program development and pitched it to the Organization Discipline Team Workshop VI at JSC on May 18, 2004. The presentation focused on the Kistler K-1 launch vehicle structures program, HyTEx PDR, PARSEC, and a couple of smaller commercial projects. The briefing covered a number of points about reducing costs and compacting schedules. The PAE participated in the rest of the workshop activities.

The PAE met with S&MA counterparts (Clint Thornton and Bryan Fuqua) at JSC to discuss S&MA tools for use in collaborative Engineering Environments. They use Sapphire and Raptor for their analysis. Their iterations cycles are on the order of days as opposed to the Preliminary Analysis of Revolutionary In-Space Engineering Concepts (PARSEC) Environment where iterations take place in 10 – 15 minutes.

The PAE developed a presentation on ways to maintain a low cost technology flight test bed program by launching rockets from high altitude balloons. The PAE has experience with balloon launched rockets (rockoons). This concept would enable higher energy missions at a fraction of the cost of the previous HyTEx sounding rocket concepts. The rocket would be launched above most of the atmosphere about 20 miles up. It could be launched at a low angle of inclination which means it can go into cruise phase immediately after booster burnout. No pullout maneuver would be required. As the original concept required a 50 g pullout maneuver with high heat loads this could significantly reduce mission risk and improve experimental test quality.

PAE participated in writing the White Papers for areas of the Shuttle Derived task applicable to the sections that were prepared by S&MA. In addition, PAE continues supporting the Human Rated Launch Vehicle Task.

The Aerojet Test Readiness Review, conducted on May 12 and supported by Project Assurance. The stated objectives of the test series included:

- a demonstration of engine performance without erosion of the injector face plate, throat or nozzle
- no streaking in the chamber, throat or nozzle.
-

PAE voiced concern over the absence of planned post-test inspections. The test plan did state that all data would be reviewed during/after each test and that the hardware would be fully inspected at the end of the series but any inspections performed between tests would be at the discretion of the test director. PAE pointed out that the presence of either condition noted above could not be determined by data review alone and that Aerojet should establish inspection intervals to detect and track the condition of the hardware. A compromise was agreed to which would have Aerojet perform bore scope inspections of the areas of concern at irregular intervals such as when run tanks are being replenished or during any significant breaks in testing. Frequency of inspections will be adjusted as dictated by the results obtained.

PAE continued to update the White Papers for areas of the Shuttle Derived task applicable to the sections that were prepared by S&MA. In addition, PAE continues supporting the Human Rated Launch Vehicle Task. Also, PAE participated in the OSP Lessons Learned final presentation that was held in Florida and which included representatives from Boeing, Lockheed Martin, Orbital Science, JSC, KSC and MSFC. The Lessons Learned presentations will be documented and be made available on Windchill Project link.

PA taught CRM Executive Overview course to ISS Payloads Furnace group: The 15 class participants were all members of the same project and expressed a keen interest in CRM. The group was experienced with CRM to some degree and used the ePORT database to track, document and mitigate their risks. The class was a success overall, and it was stressed that the CRM is available for further training of team personnel as well as assessing their risk process.

PA performed testing on IRMA 5.0 prior to acceptance by OSP: Futron delivered IRMA 5.0 as the final product to the OSP program. As part of the delivery process, in depth testing was performed on the database to ensure all requirements were met. The requirements that were not met were reviewed, troubleshot and repaired. All OSP risk data from IRMA 4.3 was successfully transferred to IRMA 5.0.

PA finalized updates to OSP Risk Management Plan Revision A: The OSP Risk Management Plan was update to include the following appendices: OSP Risk Summary Card, OSP Risk Work Instruction, IRMA Users' Guide, IRMA Earned Value Management Process and Probabilistic Risk Assessment (PRA) Overview. The concept was to have the OSP Risk Management Plan be signed by OSP management out of board, but that path was cancelled. The plan will still be revised as a draft and then archived. The plan can then be used a risk management plan template for other NASA programs.

PA attended Process Based Mission Assurance (PBMA) Training: The NASA Office of Safety & Mission Assurance sponsored a training session on NASA's newest collaborative engineering tool Process Based Mission Assurance (PBMA). This training included: familiarization with PBMA key features including: Secure Work Groups, Secure Meetings, Knowledge Registry, web collaboration and joint documentation editing and scheduling. This tool is very powerful for working groups and establishing a web-based work effort for any size project. On-line discussions can be held and work processes/procedures can be brought together in real time for all parties to buy into. If implemented properly, this tool can improve efficiency for group meetings.

In addition, PA attended Foundations of Risk Management Training during the reporting period.: The CRM course developers from Risk Management Corp. presented there course new material for review and critique. There is NASA wide effort to re-accomplish risk management training through out the agency and the MSFC CRM group was the first to review the course material. A marked change of approach was the emphasis on individual decision-making and how it could lead to the development of a risk situation. This puts the emphasis of "thinking risks" on all members of a project or program. This thought process will be incorporated throughout the other five risk management courses, currently under revision.

The PAE supported QD12 Office of Exploration Systems Work Breakdown Structure (WBS) task by participating in development of the S&MA Code-T Enterprise and Constellation Level WBS.

The PAE wrote a lesson learned pertaining to the need to maintain System Safety inputs into the Continuous Risk Management practice.

PAE supported the Cargo Task of the ETT. The Cargo Task includes the Shuttle Derived, Clean Sheet and Expendable Launch Vehicles (ELV) studies. Unlike the earlier Task 5 (Clean Sheet and Shuttle Derived) that PAE finalized and presented to Code T, this task involves vertical penetration and decomposition of the reliability predictions in support of the concepts selected for this task. PAE is preparing a detailed approach in support of the decomposition effort required.

PAE assisted in the preparation of the ground rules and assumptions for the new Shuttle Derived task. The task description, schedule and ground rules and assumptions will be presented to Code T ant NASA Headquarters for final approval to proceed. PAE also assisted in identifying current Space Shuttle and Space Station S&MA documents for reference to assist in obtaining approval from Code T to establish unique S&MA documents for the Exploration Tasks. In addition, PAE continues supporting the Human Rated Launch Vehicle Task.

PAE supported the investigation of a test anomaly on the Aerojet non-toxic, dual mode, Reaction Control Engine (RCE). Test number 134, (25% duty cycle test, 800 pulses) ran full duration but, at shutdown, gox and lox leakage was observed, indicating that the respective propellant valves had been compromised. A review of the data indicated that the engine failed to fully ignite on the initial pulse, leaving residual propellants pooled in the chamber which ignited on the second pulse, resulting in a pressure spike or "hard start". Aerojet's and the manufacturer's (MOOG) post-test inspections revealed that the ceramic portion of the spark plug had shattered and the OX valve Teflon seat was missing, presumably destroyed and consumed during the test. A detailed look at preceding tests revealed slightly reduced pressures which indicate that the ceramic material may have failed prior to test 134 and lodged in critical areas, thereby restricting propellant flows. Failure of the ceramic portion of the spark plug can be attributed to thermal effects of cold OX flow and the dynamic loads associated with previous pulse testing. After a number of potential "fixes" were discussed, the participants agreed that, a five second "lead-in" burn to reach thermal equilibrium will be performed prior to going into the pulse mode. The controller software will also be modified to add an automatic cut should the engine fail to ignite in pulse mode. Although the lead-in burn is not an option under flight conditions, it will eliminate the pooling concerns associated with horizontal testing in ambient conditions and allow the contractor to demonstrate the basic operational capabilities of the RCE. However, this issue will have to be re-addressed prior to vertical testing, in a vacuum environment at White Sands Test Facility (WSTF), scheduled for summer 2005. Additionally, go-no-go criteria, based on changes in applicable pressures, is being developed in order to establish spark plug inspection intervals.

During the reporting period, ET PA performed an assessment on the LH2 / Inter-tank flange TPS stringer injection verification. Stringer injection is the 1st step in the new enhanced 3-step application of TPS on the intertank flange. The verification test demonstrated process performance relative to the engineering requirements and verified control of processing parameters. The test also collected data on TPS voids to be compared at a later date analytically to a critical flaw size. ET PA evaluated data from the test and assessed that the verification test objectives were met. ET PA recommended that ET proceed to validation testing for this process. ET PA will continue to flow the validation of the stringer injection process and will assess the test results.

ET P) performed a PFMEA on the enhanced thermal protection system (TPS) application for the inter-tank stringers. The new application is a semi-automatic process of injecting foam through a molded end

cap into the structural stringer. The resultant TPS application is virtually void free and highly repeatable. The PFMEA analyzed 49 potential process failure causes. The PFMEA determined that previously identified process key parameters were valid and recommended that an additional parameter be added to the list with additional controls to be implemented. The PFMEA also indicated that the current process controls were acceptable and no process failure causes were identified to "Unacceptable" for flight safety risk. However, six (6) failure causes will be elevated for further evaluation to reduce process risk. This PFMEA will support the pre-validation approval process for this TPS closeout.

ET PA reviewed and approved the process verification test plan for the thermal protection system (TPS) manual spray. The manual spray operation is steps 2 and 3 of the enhanced 3-step TPS closeout on the LH2 / Inter-tank flange being developed for return-to-flight. The new process will reduce the size and number of TPS defects and eliminate the potential for critical debris shedding from the flange region of the ET. This test will verify that the new process yields a repeatable process that will meet engineering requirements of strength and internal TPS voids. ET PA assured that the proper quality requirements were incorporated in the test plan and manufacture of the test articles. ET PA also verified that the test objectives were defined properly to assure compliance to certification requirements. ET PA will monitor and assess the results of testing to determine objective compliance.

ET PA Integration attended the Bipod Redesign Delta CDR Pre-Board held on June 16, 2004 at the MAF. PAE attended the pre-board with the Quality Directive 20 (QD20) Manager, who was a Pre-Board Member, on the issues concerning the bipod redesign. At the pre-board, RIDs were discussed for potential closure.

ET PA evaluated CR-S062274, ET Foam Debris Allowables. This CR is the first of a series of Debris allowable CRs to expand the SSP requirements base in NSTS 07700 Volume X. The intent is to build upon the progress made in SSP Debris Definition efforts. This CR involves ET Foam only. Mass allowables are derived for Orbiter constraints regarding foam impact onto Reinforced Carbon-Carbon (RCC) at or below 1500 ft-lb energy levels. ET PA evaluated the CR and had the following conclusions: The debris allowable numbers were based on test and analyses. The data used in the analyses was based on 2 tests which does not give statistical significance in order to derive a design requirement of the External Tank Project. The threshold of mass to energy that results in RCC damage has yet to be determined; therefore, the requirements listed in this CR are not based on a design factor of safety and the level of conservatism and risk are not fully understood. The data upon which this CR is based is "preliminary" data. It is not up to the usual pedigree of data included in NSTS 07700. The pedigree of the data should follow the procedures called out in the SSP Master Verification Plan (NSTS 07700-10-MVP-01) for pre-declaration of test data used for certification. Based on this data, ET PA was "Unacceptable" with this CR and recommended that more testing be performed to characterize risk.

ET PA performed an assessment on the LH2 / Inter-tank flange joint volume fill candidate materials and provided inputs for a down selection trade study. Volume fill is a mitigation effort against thermal protection system (TPS) cohesive failure resulting in debris. Volume fill will provide a leak barrier between the inter-tank N2 purge and voids in the foam through various leak paths. The design challenges with volume fill are to develop a volume fill that will perform and not degrade under repeated cryogenic conditions and will not have negative impacts on surrounding hardware. The material and process must be capable of installation into a "blind", confined space. These functional requirements were taken into account in the trade study performed. ET PA will continue to follow the risk mitigation efforts of the volume fill and assure that design and process requirements are properly implemented.

ET PA reviewed and approved the process validation test plan for the thermal protection system (TPS) manual spray. The manual spray operation is steps 2 and 3 of the enhanced 3-step TPS closeout on the LH2 / Inter-tank flange being developed for return-to-flight. The new process will reduce the size and

number of TPS defects and eliminate the potential for critical debris shedding from the flange region of the ET. This test will verify that the new process yields a repeatable process that will meet engineering requirements of strength and internal TPS voids. ET PA assured that the proper quality requirements were incorporated in the test plan and manufacture of the test articles. ET PA also verified that the test objectives were defined properly to assure compliance to certification requirements. ET PA will monitor and assess the results of testing to determine objective compliance.

ET P) performed a risk assessment on the removal of volume fill from the RTF baseline design on the LH2 / Inter-tank flange. Volume Fill is to be a mitigation effort against cohesive TPS failure and debris on the LH2 / Inter-tank flange. Volume fill is a material that fills the "y-joint" in the flange region and serves as a barrier for gaseous nitrogen (GN2) through the structural gaps on the bottom half of the flange during the thermal cycles of tanking and will maintain structural integrity during multiple cryo-cycles. Recent testing has indicated process difficulties on a "retrofit" tank where foam blocks these GN2 leak paths. The blocked leak path creates a hydraulic lock on the volume fill material and proper fill cannot be performed and/or verified. ET PA performed a risk assessment of not performing a volume fill on the RTF retrofit tanks. ET PA concluded that implementation of volume fill on retrofit tanks does not decrease risk in regards to TPS debris. ET PA recommended that issues with gap penetration, interactions between leak rates / void size and structural impacts need to be understood and mitigated. ET PA will continue to provide risk guidance on the enhancement efforts on the LH2 / Inter-tank flange.

ET PA performed a PFMEA on the enhanced thermal protection system (TPS) application for the inter-tank stringers. The new application is a semi-automatic process of injecting foam through a molded end cap into the structural stringer. The resultant TPS application is virtually void free and highly repeatable. As part of the PFMEA process, ET PA has completed a Process Flow Chart which defines the steps within the process and the process controls associated with those steps. The PFMEA has been initiated from the Process Flow Chart. The PFMEA will analyze the processing steps by identifying potential process failure modes and associated causes and effects. The controls will be identified and adequacy determined. A relative risk number will be ranked based on probability of failure occurrence, severity, and detection capability. Based on the outputs of the PFMEA, additional controls may be added to the process to reduce risk. ET PA will continue to develop the PFMEA for the stringer injection process as well as the other redesign efforts on the ET flange for return to flight.

ET PA provided inputs and direction to a draft Integrated Process Control (IPC) Plan for the External Tank. The plan defines guidelines and requirements for process controls for key processes to ensure a consistent, quality product. The plan will define these key processes as controlled processes which configuration change control authority will reside with the Chief Engineer's Review Board at MSFC. The plan also defines the various inputs that create an integrated controlled process, such as supplier control, material control, process parameter control, product parameter control, contamination control, and operator certifications. ET PA suggested that Process Failure Modes and Effect Analyses (PFMEAs) be utilized within the process to identify and eliminate/control potential failures that would affect product functionality. ET Return-to-Flight Management concurred with the use of PFMEAs and has incorporated as a requirement prior to process validation tests. ET PA will continue to follow the IPC efforts and will serve as the MSFC lead for the PFMEA efforts.

ET PA initiated a PFMEA on the LH2/Inter-tank Flange enhancement of stringer injection. The stringer injection is an enhancement process of applying thermal protection system (TPS) inside the structural stringers of the Inter-tank. This new process is a semi-automatic process which results in an elimination of TPS voids which is a cause of foam debris on the ET. The PFMEA is an analytical tool used to identify potential process problems the same way a Failure Modes and Effects Analysis (FMEA) is used to identify and eliminate or control potential failures that affect a product's function. The PFMEA will also identify process parameters which need additional or improved controls to detect and prevent

failures. ET PA is serving as the technical expert in the execution of the PFMEA and will provide technical inputs on the injection process.

PAE finalized the Shuttle Derived Study as the Lead Engineer for the In-Line concepts. The final presentation was made by the ET management to Code T on May 5, 2004. It was very well received. In addition, PAE is supporting the Human Rated Task which was finished June 15, 2004.

ET PA reviewed and approved the test plans for the thermal protection system (TPS) stringer injection closeout. Root cause testing has demonstrated that voids in stringer foam can result in cohesive failures and debris during ascent. Dissections indicate that with the base-lined process, stringer foam closeout may contain large voids and are not in process control. Stringer Injection is a mitigation effort against cohesive TPS failure and debris. Stringer injection process will provide a void-free closeout which will encapsulate the threads of the flange bolt while meeting structural and thermal requirements. The injected stringer will also provide a simplified substrate in which the remaining manual closeout will be sprayed. This will allow a reduction in operator variability which will aide in the assurance of foam application compliance of the final closeout. ET PA reviewed the test plans and provided change comments to incorporate proper verification requirements. The changes were incorporated within the test plan and ET PA approved the test plan. The changes revolved around the definition of key process and product characteristics and inclusion of the characteristics in the test objectives. Control and verification of these key characteristics will be documented within the acceptance rationale and retention rationale in the ET Hazard Reports and Failure Modes and Effects Analysis/Critical Items List.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

An executive overview to Continuous Risk Management (CRM) course was conducted for a generic group project leads and engineers working at Marshall on NASA projects and programs. This course provides a snapshot of CRM process to senior engineers and project managers.

The OSP Program Planning and Control Office to donated risk management tools and resources (software, equipment and personnel) to S&MA/QS-40 to support the CRM effort. The IRMA tool was offered to aid in the implementation of the CRM process in data collection and documentation. S&MA/QD40 agreed to accept the resources and review the implementation of IRMA as a CRM tool.

To advertise and support the Marshall directive on promoting CRM in all projects, the CRM group has developed a promotional flyer that will promote CRM training through out the Marshall Space Flight Center. This flyer will be published and distributed through out the center as a promotional/educational tool on how access CRM training for MSFC NASA programs and projects.

Risk Management (RM) provided IRMA database training to fifty percent of the S&MA/QD40 CRM group. The training illustrated the connectivity between the CRM process and the IRMA data structure. Emphasis was placed on the availability of the database, its online help function and the ease of report generation.

NASA management in the office of Safety and Mission Assurance/Code Q has directed that risk statements will no longer be tied to an "if – then" definition. This direction prevents the risk developer/owner from "going down the wrong path" of defining a risk statement. This change in thought process illustrates a more structured risk definition process and allows for the development of a more structured risk statement process. Current CRM instructional material will be modified to implement the new risk statement development process.

Project Assurance (PA) for RM provided a one half day presentation of Continuous Risk Management for the subject project with a follow on risk identification workshop scheduled. There were 3 participants locally in the class held at the Marshall Institute and 3 participating by teleconference at JSC, Goddard and Ames. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

RM conducted a four hour CRM training review session for the ISP project.

The CRM brochure was developed at the request of QD40. It purpose is to promote CRM and the capabilities of the CRM support team to include: CRM training, assistance in developing risk management plans, risks lists and risk mitigation plans.

The ePORT training course was conducted for all the ISP key project personnel. It incorporated CRM theory that was covered in the morning CRM overview as well access to the database, data entry and sample reports.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

Work continues with the Overarching model and Naming Scheme PRA teams as well as with SRB-ORB APU PRA team in order to formulate strategies for implementing the IPR comments into the PRA Fault Tree and PRA methodology.

PRA prepared analysis results, a presentation, and presented the results to the IPRP on 05/13/04 during the 'Shuttle Probabilistic Risk Assessment' (SPRA) Database meeting in Rockville, MD. The analysis compared four methods for developing composite generic prior distributions for functional failures.

PRA attended the SPRA Database meeting with the IPRP in Rockville, MD on 05/13/04 – 05/14/04 to review MX and NC briefing on "SSP PRA Buy-in". A follow up meeting was held with the NASA MSFC PRA Shuttle Lead to review and discuss results of SPRA Database meeting.

Risk Assessment (RA) worked with SSME PRA team and HQ Code Q on implementing the recommended the failure data discount methodology using Excel spreadsheet, and started putting together a draft paper on the revised methodology.

PRA developed and delivered a listing of ET basic event names and failure modes to JSC in order to support the development of basic event naming schemes. Data analysis results were also developed in support of the Data Analysis team; responsible for developing methodology and documentation for Shuttle PRA baseline.

Work on performing sensitivity analysis has begun on selected SSME major components and discussions with the SSP PRA schedules as well as modeling issues discussed with the SSP PRA technical manger.

A list of SRB basic event names and descriptions to determine the use of naming abbreviations was compiled; comparison tables to compare SRB and ORB APU failure rates have been developed. The Shuttle PRA data analysis meeting in Washington D.C. was represented along with the IPR. Sensitivity analyses have been performed on some of the SRB APU leakages using new methodology.

R&M discussed proposed updates to the SRB PRA modeling methodology with SRB PRA team, QD40 and Shuttle PRA (SPRA) technical leads. R&M followed up the discussion on the propulsion elements modeling methodology and efforts Shuttle PRA technical leads and MSFC SPRA lead.

4.7.3 Reliability Prediction & Risk Analysis

A Gauge Repeatability and Reproducibility (R&R) study, requested by Risk Assessment (RA), was performed on new ETAR portable hardness detectors. The devices were found to be very capable when measuring hardness on calibration tiles and little variability was found due to and between operators. Discussions are ongoing regarding fracture toughness data. RA has supplied an answer on number of samples required to reach a 99% prediction limit with 95% confidence (and other values).

Risk Assessment (RA) was asked to support this team looking at detecting cracks in the Main Propulsion System (MPS) flow liners and flow liner repair welds using Non-Destructive Evaluation (NDE). RA had recommended using the log logistic probability of detection method now used by the military and other industries. A consultant will be brought in to help with the study. RA attended and provided input to a technical interchange meeting discussing the issue.

The External Tank (ET) Return to Flight Statistical Support Team outlined a portion of an Integrated Process Control Plan (IPC) for Team 10 (Bipod) which may eventually be used for ET as a whole. This portion regarded the data analysis portion of process control, including well-designed experiments and other techniques to characterize processes, Gauge Repeatability and Reproducibility (GRR) studies to ensure that measurement systems are capable of delivering good data, Statistical Process Control (SPC) methods to effectively monitor processes in real time, and robust sampling plans with known levels of uncertainty.

RA attended the Society for Industrial and Applied Mathematics (SIAM) Data Mining conference addressing the latest techniques in analyzing large datasets. Several techniques will be useful. New "query" software was presented that will recognize a given trace shape in a portion of a time series graph, then look for similar traces in other time series. This could prove useful in examining flight or test data from SSME or RSRM. A Bayesian approach was presented that looks at data clusters in two dimensions. The approach results in a count and a description of data clusters. This is useful for complex data where it is difficult to see whether there are, say, only two clusters, or if there are potentially several. Another approach to multidimensional cluster data showed an apparently simple way to find and count clusters in large datasets.

RA was asked to support this team looking at detecting cracks in flow liners and flow liner repair welds using NDE. RA attended and had material input in a TIM discussing procedures and activities for this issue. It was found that it may be possible to run a smaller number of samples than anticipated. Several innovative methods for creating crack samples were discussed. RA put full support behind a recommendation by a consultant expert to calibrate test equipment using a several calibration standards with test values distributed across the anticipated measurement range rather than using a single calibration standard. This is the equivalent of running a "mini POD (probability of detection study)" each time the machine is calibrated, and ensures that the unit is operating as expected each time it is calibrated.

RA assessed historical data regarding off-nominal performance of studs restraining the shuttle on the pad. Several analyses were run. It was found that flights originating from Mobile Launch Platform (MLP) 2 were slightly less likely to experience an anomaly that events were more likely than expected to happen in clusters in time, and other findings.

RA compiled and delivered proposed presentation charts to SPRAT for review and participated in the Completed Root Cause Analysis Training.

RA worked with Boeing Rocketdyne, SSME Project and MP-71 on populating the SSME-MPS contamination risk assessment models with preliminary SSME PRA results; and with Boeing MPS, JSC

SMA, JSC EP4 and TD-53 on the MPS contamination models and how to best use the available MPS PRA results.

RA assessed historical data regarding off-nominal performance of studs restraining the shuttle on the pad. Several analyses were run. It was found that flights originating from Mobile Launch Platform (MLP) 2 were slightly less likely to experience an anomaly, that events were more likely than expected to happen in clusters in time, and other findings.

RA was asked to evaluate several issues regarding the Redesigned Actuator Bracket 5/8" Bolt Attach Torque/Preload Characterization. MSFC M&P had a question regarding L spacer and torque method. RA found that replacing the L spacer with a reduced hardness range spacer would not substantially reduce peak preload variability. RA further concluded that the torque method was reasonable and the variability due to the torque twist method was within bounds, however other factors in the test affect overall variability. RA recommended additional testing adjusting snug torque level as a means of potentially reducing overall variability.

Enhanced data comparing the old BX-250 spray foam, which was used on STS-107, to the newer BX-265, as well as manual v automatic sprays and foam tin catalyst level, was analyzed. RA compared BX-265 automatic spray to BX-265 manual spray and BX-250 automatic to manual sprays. RA found that there were few significant differences in most cases, but that BX-265 manual sprays could be characterized as a different family than the others. These and earlier results were reported to Lockheed Martin and NASA Team 10 sub-team and Statistical Support Team personnel, and were folded into one summary document for presentation to a wider audience. A statistical assessment of the Precontrol process control technique was demonstrated to the RTF Statistical Support Team and others. The beta risk, the chance of not getting an alarm given a particular process capability (C_p) and shift in the mean, and the number of trials that could be run before getting an alarm were described in the assessment. The team now is apprised of these risk factors involved in using this technique.

SSME ultrasonic fastener stretch measurement equipment is being updated from relating Erdman counts to load to relating load to delta time. Risk Assessment (RA) was asked to analyze the data for this testing. The main testing is being performed at Canoga Park and MSFC is performing a portion of the testing here to evaluate differences in location and to assure the accuracy of the readings at Canoga Park. RA performed initial data analysis for the first fastener of part 1 and presented the findings to the team. RA also analyzed and presented data on the second fastener.

RA worked with MSFC PSIG, SSME Project, MSFC SMA, JSC SMA, and Boeing on the MPS contamination affecting SSME and MPS. R&ME also aided the team in formulating presentation charts to PSIG and an upcoming ICB. Proposed SSME PRA data analysis methodology was presented to the Shuttle PRA team and IPR. On-going efforts with the SSME PRA team continue on the SSME PRA data analysis.

4.7.4 OSP Risk Assessment

Risk Assessment (RA) reviewed the IRMA Administrator's Guide for accuracy of content and implementation among the IRMA community.

RA performed a process review of the Joint Strike Fighter vs. the current Orbital Space Plane. This review will determine the similarities as well as the differences of both risk management process. Findings will be incorporated into the revised OSP risk management plan and be used as a template for future NASA Code Q risk management efforts.

RA developed and submitted OSP Risk Management Lessons Learned to OSP senior management. Lessons submitted included: No senior risk management review process for primary risks, the current software review/evaluation process is inadequate and needs to be re-evaluated and lack of a risk related budget review process. Additional lessons learned were submitted to address the lack of IRMA developer documentation and its availability.

To aid in the unbiased selection process of risk management database software, a comparative matrix of capabilities (Active Risk Management vs. Integrated Risk Management Application) has been submitted for review by NASA management in the Office of Exploration Systems/Code T.

Code T requested that RA perform a preliminary risk analysis (on a four launch option) in order to support a lunar mission. RA is stemming from the analysis done for the Exploration Task Team Task 5, where RA produced Loss of Mission (LOM) numbers for clean sheet and shuttle derived launch vehicles.

RA worked with fellow HEI presenter and QD40 on a presentation on the use of PRA in OSP for an upcoming risk assessment conference in Berlin, Germany.

RA constructed an event tree. That was in support of the four launch lunar mission option which is from earth to L1. In conjunction with the event tree, RA performed a preliminary Loss of Crew uncertainty analysis for the Crew Exploration Vehicle (CEV) on ascent.

MSFC S&MA presented their paper on the use of PRA in OSP at International Conference in Probabilistic Safety Analysis and Management (PSAM 7) conference in Berlin Germany.

RA was responsible for analyzing clean sheet and shuttle derived vehicles for the Exploration Task Team (ETT) and producing Loss of Mission (LOM) results for each. For each vehicle, RA took the Loss of Payload (LOP) results for a single launch and performed a Probabilistic Risk Assessment (PRA) on each design providing a mean LOM number and a corresponding uncertainty distribution. The results were then presented to the ETT for their midterm review.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicial acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.